

Bit erse Technical Information Comes ATTN: DEC.-41 8125 John J. Kilgman Rood, Salie 9844 For Balvay, No. 2590-6219 Commission F.D. 207.9120 0581-427.9120 Nov. 100.951.9119 Bernald: 30.000.011



NTIAC Story 1 Story 2

Aging Aircraft Maintenance Depends on Effective Nondestructive Evaluation

NTIAC is playing an important role in maintaining aircraft airworthiness over unprecedented lifespans. The challenge to the military, the FAA, and the aviation industry is to assure adequate inspection and maintenance of both structural and non-structural components of an aircraft as long as it remains in service. As airplanes age, the need to inspect, repair, or replace parts changes, increasing over time. And the maintenance of aging aircraft affects fleet readiness.



As aircraft get older, the primary threats are widespread fatigue, damage, and hidden corrosion, which degrades the structural integrity of the aircraft. Specific needs for aging aircraft include the detection of fatigue cracks under fasteners; small cracks associated with widespread fatigue damage; hidden corrosion; cracks and corrosion in multi-layer structures; and stress corrosion cracking in thick sections.

Continued on Story 1



Guided wave inspection of inaccessible piping that is sandwiched between the wall and a large generator.

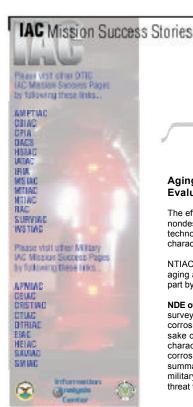
Quick Turnaround Qualification of Insulated Piping System

Aboard USS Stump (DD 978) corrosion under insulation on shipboard piping is a serious problem, in particular as ships get older. Visual inspection techniques that require removal of pipe insulation are prohibitively expensive in both labor and material costs, and are very time consuming. Responding to a request by the Port Engineer for the USS Stump (DD 978), NTIAC applied newly developed guided wave ultrasonics NDE technology to inspect bleed air piping on the USS Stump. The bleed air piping is a high temperature system that is fully insulated.

large generator. temperature system that is fully insulated. The request was made by the Stump's Port Engineer because the ship had experienced an unexpected failure in the bleed air piping during a previous deployment and a rapid turnaround was needed since the ship was to be redeployed shortly.

Continued on Story 2

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NTIAC Story 1 Story 2

Aging Aircraft Maintenance Depends on Effective Nondestructive Evaluation (continued)

The effective maintenance of aging aircraft is vitally dependent on implementing effective nondestructive evaluation (NDE) methods. Proper application of currently available NDE technology can offer significant improvements in diagnostic capabilities and provide characterization of the damage necessary to develop effective structural repairs.

NTIAC offers valuable expertise and resources in the campaign to extend the service life of aging aircraft. Recent related state-of-the-art reports and technical assessments, funded in part by the U.S. Air Force and NASA, include—

NDE of Hidden Corrosion—This state-of-the-art report presents a survey of the status of development of NDE techniques for detecting corrosion, in particular hidden or inaccessible corrosion. For the sake of completeness, a discussion is presented on the characteristics of corrosion in terms of corrosion mechanisms, corrosion damage, and corrosion detection and measurement. A summary of results from a recent survey of NDE for corrosion in military systems is also presented. Hidden corrosion is a primary threat to aging aircraft.



NDE of Cracks
in
Aircraft—This
state-of-the-art
report presents
development or

NDE of Cracks in Aircraft—This Hidden corrosion is a primary threat to aging aircraft.

report presents a survey of the status of development of NDE techniques for detecting cracks, with emphasis on detecting cracks in aircraft structures. A discussion is presented of general considerations regarding how cracks are taken into account in aircraft structural integrity. A brief synopsis is given of damage tolerance

considerations and the importance of widespread fatigue damage is discussed. Fatigue damage is forcing the retirement of the C-141 fleet.

NDE of Residual Stress in Metals—This state-of-the-art report presents a summary of the status of the nondestructive determination of residual stresses in metals. The report focuses on the NDE techniques of diffraction (X-ray and neutron), ultrasonics, and electromagnetics; however, several approaches still under investigation are discussed. Background information on residual stresses and their measurement is presented, as well as various methods for determining residual stress. Landing gear struts are susceptible to stress damage.

Fatigue damage is forcing the retirement of the

C-141 fleet.



Landing gear struts are susceptible to stress damage.

Digital Radiography—This technical assessment presents the current state of technology development in digital radiography.

After a brief discussion on the background of digital radiography, information is presented on the state of various detection and imaging technologies, selected application examples, and modeling and standards. Tabular comparisons are presented for various imaging methodologies of principles of operation, hardware and software requirements, advantages and limitations, area of coverage,

reported sensitivity, ease of implementation, and archiving of data and images.

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NTIAC Story 1 Story 2

Quick Turnaround Qualification of Insulated Piping System Aboard USS Stump (DD 978) (continued)

NTIAC had previously participated in development of the guided wave ultrasonics NDE technology under sponsorship of the Office of Naval Research. Using guided waves travelling down the length of an insulated pipe, this technology is capable of detecting corrosion pitting and generalized wall thinning with removal of only minimal patches of insulation periodically for application of the sensors to the pipe. Using this technology, pipe lengths 20 to 30 feet long can be inspected without removing insulation.

NTIAC demonstrated application of the guided wave technology by inspecting approximately 180 feet of bleed air piping aboard the USS Stump in Norfolk, Virginia. Although the vast majority of the piping was found to be fit for service, areas suspected to contain damage were marked for additional inspection by the Navy prior to redeployment and to direct monitoring of the piping systems during sea operations.

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Guided wave inspection of bleed air piping in an engine room; guided waves travel in the pipe, around the bend and down to a flange on the deck below